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ABSTRACT

The determination of the thickness of a sludge blanket in primary and secondary clarifiers and in gravity thickness is important in making operational control decisions. Knowing the thickness and concentration will allow the operator to determine sludge volume and detention time. Designed for individuals who have completed National Pollutant Discharge Elimination System (NPDES) level 1 laboratory training skills, this module provides waste water treatment plant operators with the basic skills and information needed to: (1) successfully measure the depth of the sludge blanket in a clarifier or gravity thickener and (2) obtain reliable, consistent results using the procedures outlined. The instructor's manual contains a statement of instructional goals, lists of instructor/student activities and instructional materials, narrative of the slide/tape program used with the module, and student worksheet (with answers). The student workbook contains objectives; sources of materials (electronic blanket finders, sight glasses, and core samples); laboratory procedures using sight glass, electronic, and core sampler methods; instructions for constructing blanket finders; and student worksheet. No special prerequisite skills are needed before starting this module. (Author/JN)

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Operational Control Tests

for Wastewater Treatment Facilities

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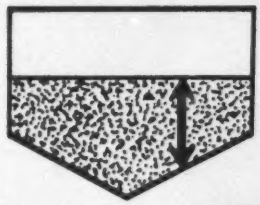
Depth of Blanket

Instructor's Manual



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DEPTH OF BLANKET

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DEPTH OF BLANKET

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INSTRUCTIONAL GOALS

Upon completion of this lesson the student should be able to successfully measure the depth of the sludge blanket in a clarifier of gravity thickener.

INSTRUCTOR ACTIVITY

For best results follow this sequence:

	ACTIVITY	TIME
1.	Review the objectives with the student.	5 minutes
2.	Assign the reading of the procedures.	10 minutes
3.	View the slide program.	12 minutes
4.	Demonstrate the test procedure.	15 minutes
5.	Have students perform the test.	30 minutes
6.	Assign the worksheet.	10 minutes
7.	Correct the worksheet.	5 minutes

THE DEMONSTRATION: The above sequence should be followed if time allows. Also, unless there is a sewage treatment plant available it will not be possible to either demonstrate or perform this test.

If a plant is available be sure to emphisize the importance of locating the rake arms prior to putting the blanket finder in the water.

Because of the problems associated with actually finding the blanket with the sight glass you may wish to instruct each of the students individually.

If you do not have a sight glass blanket finder you may wish to construct one. Details on construction can be found in the student materials.

STUDENT ACTIVITY

1. Read the objectives.
2. Read the procedure.
3. View the slide program.
4. Perform test.
5. Record data.
6. Complete worksheet.

INSTRUCTIONAL MATERIALS LIST

1. Instructors Guide for Depth of Blanket
2. Student Workbook for Depth of Blanket
3. 35 mm projector
4. Cassette tape player with automatic synchronization
5. Projector screen
6. Equipment listed in the lab procedures

NARRATIVE

Slide #

1. This lesson describes the process used to measure the depth of a sludge blanket in a settling basin. Three different devices used to make the measurement are described, along with the procedure for each device.

2. The lesson was written by Mr. E. E. Arasmith. Instructional development was done by Priscilla Hardin. Dr. John W. Carnegie was the project manager.

3. As an operational control tool, it is desirable to be able to determine the total volume of solids in any wastewater system.

4. Historically, it has been difficult to make this determination in clarifiers and gravity thickeners due to the inability to estimate the thickness of their sludge blankets.

5. Several unique methods have been developed to make this measurement. They include a hand held site glass, the electronic blanket finder, and core samplers. In this lesson we will discuss the operation and use of each of these three pieces of equipment.

6. With all of these instruments what we really want to do is determine the average thickness of the blanket. There are two methods for doing this.

7. One is to measure the blanket thickness directly with the core sampler.

8. The other requires the determination of the depth of water above the blanket which is called DOB or Depth of Blanket.

9. This value is then subtracted from the average water depth to find the blanket thickness.

10. The average depth of a tank is a onetime measurement. In rectangular tanks, this measurement is made at ½ of the length of the tank.

11. For a circular tank with a cone-shaped bottom, this average depth is the depth at 1/3 of the radius in from the side wall.

12. The point at which this measurement is taken should be clearly marked on the tank catwalk. Well, so much for the theory; let's go on to the actual procedure.

13. Before we look at specifics, let's preview this three-step process. The first step is locating the sample site. The second step is either measuring the distance from the top of the water to the blanket (called DOB) or measuring the blanket thickness. And finally, the data is recorded for further use.

14. Let's start by selecting a sample site. There are two conditions: circular tanks and rectangular tanks.

15. With circular tanks the DOB is usually determined at a point 1/3 of the radius from the outside edge. This is the point at which the average water depth was determined.

16. This measurement should be taken at the same time each day or shift and when taken in conjunction with settleometer and centrifuge tests it should be taken at the same time these samples are collected.

17. Basically, the measurement involves four steps. First, observe the rake arm position. Second, lower the finder to the top of the blanket. Third, measure its depth. And finally, record the data.

18. After selecting a site, you need to observe the position of the rake arms. For best results, the measurements should be made when the rake arm is 90^{o} from the measuring point.

19. This is done because the rake arms will billow the sludge in front of them and leave a sludge blanket deficit behind them.

20. Besides the problems of incorrect reading in front or in back of the rake arms, there is the possibility of damage to the blanket finder.

21. On a rectangular tank, the measurement should be midway of the length. At this point the blanket has formed sufficiently to give an average depth.

22. Now we are ready to proceed to step 2. There will be three types of equipment discussed in this lesson.

23. Let's start first with the site glass.

24. What we need is a long aluminum tube 1¼" or 1½" in diameter. A site glass is placed over one end and a light source is placed just beyond the site glass.

25. A power source switch is provided to activate the light.

26. The tube is marked off in 1 ft. and ½ ft. increments.

27. Move out to the sample site.

28. Check the location of the rake arm. Remember, it should be 90^{o} from the sample site.

29. Turn on the switch and check the light.

30. Slowly lower the blanket finder.

31. As soon as possible, start the observation.

32. As the finder descends, you will pass through dispersed floc and the light will become cloudy. Keep moving downward.

33. The light will get dimmer as the finder passes through thicker and thicker solids. At the top of the blanket, the light should go out. Stop at this point.

34. Do not puncture the blanket. This will cause a billowing and the light will reappear causing you to descend further, resulting in an inaccurate DOB reading.

35. There are three ways of observing the readings. First, the tube may be marked so that it can be read directly.

36. You may wish to slowly remove the tube, counting the marks as it is removed. Or you may wish to remove the tube and determine the length from the water mark on the tube.

37. After the reading has been observed, it should be recorded in feet and tenth of feet.

38. After the blanket finder is removed, turn the switch off and store the finder at a convenient, safe place.

39. Let's take a look at measurements with the electronic finder. There are two types of electronic blanket finders: one that has an audible signal and one with a visual display.

40. The visual unit is composed of a readout display, a light source, and a photo sensing device.

41. Turn the power on and check the light source.

42. Remember to check and make sure the rake arm is 90^{0} from the sample site.

43. Lower the sensing head into the water. Stop just below the surface.

44. Adjust the device to maximum deflection.

45. Slowly lower the sensor, watching for a deflection of the needle. As the sensing device passes through the settling floc, a slight needle deflection should be noted.

46. When the sludge blanket is encountered, the needle will suddenly deflect to one side.

47. The depth should now be determined by counting off the feet of cord as it is pulled up.

48. Then put the instrument away in its storage place.

49. The third method to be discussed is the use of a core sampler. As you recall, with this device we can directly read the blanket thickness.

50. The core sampler is a long, clear plastic tube with either a manually operated valve on the top or an automatic valve on the bottom. The one we are going to use has a valve on the bottom.

51. Remember the rake arm.

52. Slowly lower the tube straight down to the bottom of the tank. As the sampler starts down, the water will push the automatic valve open, letting the water fill the tube. Lower the tube slow enough to keep the water level in the tube the same as the tank level. Continue downward until you hit the bottom of the tank.

53. Then slowly lift as straight as possible. As you lift, the valve will automatically close and capture the core sample.

54. The depth of the blanket can now be measured directly by reading the scale on the tube.

55. Some operators prefer to slowly empty the solids from the core samplers into a container. A sample of this mixture can then be used to determine average sludge blanket concentration.

56. The core sampler should now be rinsed with clear water and stored.

57. So far in this procedure we have seen the basic use of the blanket finder.....

58. the types of feeders, and.....

59. how to measure the blanket with each. The blanket finder has other operational uses.

60. These include alerting the operator to rising sludge blanket problems in time for corrective action.

61. It can be used along with other calculations to determine sludge detention time.....

62. and overall solids inventory.

63. It can be used to help balance withdrawal rates from secondary clarifier draft tubes.

64. It can be used to help balance inflow and withdrawal rates from multiple secondary clarifiers.

65. By making multiple measurements across the clarifier or gravity thickener, the action of currents may be detected.

66. And finally, by trend charting average values along with other data, overall plant performance can be evaluated and related to blanket depth.

67. In summary, this procedure can be used to determine the total volume of solids in clarifiers and gravity thickeners. It also can and should be used to evaluate clarifier operations where knowledge of the blanket volume or position is needed.

APPENDIX A

For information on construction of blanket finders refer to Student Manual, Supplementary Material.

DEPTH OF BLANKET

WORKSHEET

1. On circular tanks the DOB is measured:

   a)_____1/3 the diameter from the wall.
   b)_____1/2 the distance between the wall and center well.
   c)_____2/3 the distance from the left rail.
   d)__X__1/3 the radius from the outside wall.
   e)_____None of the above.

2. The major purpose of the blanket finder is to determine the:

   a)_____depth of the tank.
   b)_____concentration of solids in the tank.
   c)_____average height of the dispersed floc.
   d)_____the settling characteristics of sludge.
   e)__X__None of the above.

3. When using the blanket finder in determination of solids inventory the measurement that is really wanted is:

   a)_____average clarifier depth.
   b)__X__blanket thickness.
   c)_____depth of blanket.
   d)_____thickness of supernatant.
   e)_____None of the above.

4. The blanket finder should be:

   a)_____lowered as fast as possible.
   b)_____lowered at a rate of 0.5 ft/sec.
   c)__X__lowered slowly but steadily.
   d)_____lowered in 2 ft intervals making readings after the 5th foot.
   e)_____None of the above.

5. When measuring DOB the valve arms should be at _____degrees to the measuring point.

a)_____180 degrees

b)_____ 25 degrees

c)_____ 45 degrees

d)_____120 degrees

e)__X__ 90 degrees

6. You have reached the top of the blanket:

a)__X__when the light has just went out.

b)_____when the light first begins to dim.

c)_____one foot after the light creates a glow but the bulb is not distinguished.

d)_____when the light goes out the back one foot.

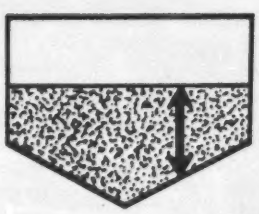
e)_____None of the above.

Operational Control Tests

for Wastewater Treatment Facilities

Depth of Blanket

Student Workbook



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DEPTH OF BLANKET

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DEPTH OF BLANKET

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INTRODUCTION

This lesson on the use of sludge blanket finders is intended to give the operator the basic information necessary to obtain reliable, consistant results with the instrument. The mention of any brand names should not be taken as an endorsement of that material.

This test procedure is intended to be performed by individuals who have completed the NPDES level I Laboratory Skills training and the WPCF Basic Course.

OBJECTIVES

Upon completion of this lesson you should be able to:

1. The location of the sample sight.
2. The major purpose of the blanket finder.
3. Recall 3 types of blanket finders.
4. Describe the procedure for using a blanket finder.
5. Perform the DOB determination.

PREREQUISITE SKILLS

There are no skills required other than those mentioned in the Introduction.

RESOURCE LIST

Electronic blanket ifnders may be purchased from:

1. Keene Corporation
   1740 Molitor Rd
   Aurora, IL 50507
   Model 8000 SCCS

2. J and S Electronics
   Rt 1 Box 83
   Tangent, OR 97389
   Model 67A

Sight glasses may be purchased from:

1. Gitz Mfg. Co.
   1846 South Kilbourn Ave
   Chicago, IL 60623
   Part #4045 for 1½" pipe

2. Raven Manufactured Products
   8355 Vine Street
   Cincinnati, OH 45216
   Model C - 10

Core samples may be purchased from:

1. Nasco
   Modesto, California 95352
   1-800-558-9595

2. Nasco
   Attlinson, Wisconsin 53538
   1-800-242-9587

Further information on the performance of this test may be found by obtaining the following written material:

1. Operation Control Procedures for the Activated Sludge Process, by Al West, available from USEPA-NTOTC, Cincinnati, Ohio.

2. Procedures used in Conducting Selected Activated Sludge Control test, by Owen Boe, abailable from Linn-Benton Community College, Albany, Oregon 97321.

DETERMINATION OF SLUDGE

BLANKET LEVEL

INTRODUCTION

The determination of the thickness of the sludge blanket in primary and secondary clarifiers and in gravity thickness is important to making operational control decisions. Knowing the thickness and concentration will allow the operator to determine sludge volume and detention time. This measurement would also alert the operator to the possability of a rising blanket and allow for operational changes in order to avert plant upset. The common methods of performing this test include site glass, eletronic depth finder, sonic depth finder, core sampler, and a small pump. This test procedure will deal with 3 of the above devices.

EQUIPMENT

Sight Glass	sight glass for 1½" pipe Gits Manufacturing Port #4045
Electronic	Keene Corporation Model 8000 SCCS portable sludge level detector.
	J and S Electronics Model 67A portable sludge blanket finder
Core Sampler	

PROCEDURE - Site Glass

1. SELECT SAMPLE SITE

   a) For circular tanks you should be 1/3 of the tank radias from the out side wall.

   b) For rectangular tanks measure midway of length.

   Beware of rake arm

2. TURN ON LIGHT SOURCE

   Check to make sure light is on and that the batteries are new.

3. LOWER THE FINDER

The blanket finder should be lowered slowly and should be stopped before it enters the blanket.

4. START OBSERVATION

As soon as the finder is low enough to allow look down the tube, start observation.

5. CONTINUE LOWERING FINDER

As the finder goes down you should observe the formation of sludge particles continues through the dispersed particles until the light suddenly goes out. This is the top of the blanket. Don't go through the blanket and then back up. You will obtain false readings.

6. OBSERVE LEVEL

Once the top of the blanket has been reached the water level on the finder should be noted. The level from the top of the water to the top of the blanket is referred to as the DOB or Depth of Blanket.

7. REMOVE THE BLANKET FINDER

8. RECORD THE DATA

The DOB is recorded in feet and tenths of feet.

PROCEDURE - Electronic

1. SELECT SAMPLE SITE

Same as 1 above.

2. TURN ON INSTRUMENT

Adjust or zero as necessary.

3. LOWER INSTRUMENT

Lower the measuring device until it indicates the top of a blanket. This can be indicated with a meter, light or audible tone.

4. OBSERVE LEVEL

The level to be observed may have to be determined by raising the instrument and noting the depth.

5. REMOVE INSTRUMENT

6. RECORD DATA

The data is recorded in feet and tenths of feet as DOB.

PROCEDURE - Core Sampler

1. LOCATE SAMPLE SITE

Same as 1 above.

2. OPEN CORE SAMPLE VALUE

With some samples this may be done automatically.

3. LOWER SAMPLES

The samples should be lowered smoothly to the bottom of the tank.

4. CLOSE CORE SAMPLE VALVE

With some samplers this may happen automatically.

5. REMOVE SAMPLER

Lift straight up.

6. READ BLANKET THICKNESS

Read the distance from the bottom of the sampler to the top of the sludge. (this is blanket thickness, not DOB)

7. EMPTY SAMPLER

Dump sample into the tank.

8. CLEAN SAMPLER

Rinse with clean water.

9. RECORD DATA

Record the data as blanket thickness in feet and tenths of feet.

SUPPLEMENTARY MATERIAL

The biggest difficulty in making sludge blanket level readings is being consistant. There is some disagreement when using the sight glass about the exact location of the interface. Some say it's as the light becomes completely dispersed but a glow is still visible. While others indicate that it is at the point that the light goes out. It is not that critical. What is critical is that the measurement be performed in the same manner by all operators.

Due to hydraulic loading the blanket level in most plants will vary drastically during the 8 to 10 hours in the morning and then again during the evening peak. It is important that control data be collected that is representative of the normal conditions. This would be at average flow rather than maximum flow. If there is problems with plant performance you may wish to compare blanket levels at maximum flow with normal flow.

Sample Site

Be sure to mark the sample location on the cat walk handrail. This will help assure corsistant readings. It is also important that the DOB readings be made at the same time each shift. Usually this need be done only once per shift.

Application

1. The most common use of the DOB in secondary clarifiers is in the solids inventory calculations. This measurement, when used with an average clarifier sludge concentration will give a solids volume in the clarifier.

2. The DOB reading may indicate a rising blanket and allow the operator to make adjustments before the blanket actually goes over the weir.

3. This measurement can be used with centrifuge spins to help balance secondary clarifier draft tubes. The balance here is one

of comparing solids concentration to blanket level and adjusting the draft tubes to obtain a fairly level blanket while obtaining fairly constant draft tube concentrations.

4. When there is more than one clarifier being fed by a single basin the inflow rates are related to blanket levels; thus, the blankets can be used to indicate balanced or imbalanced inflows.

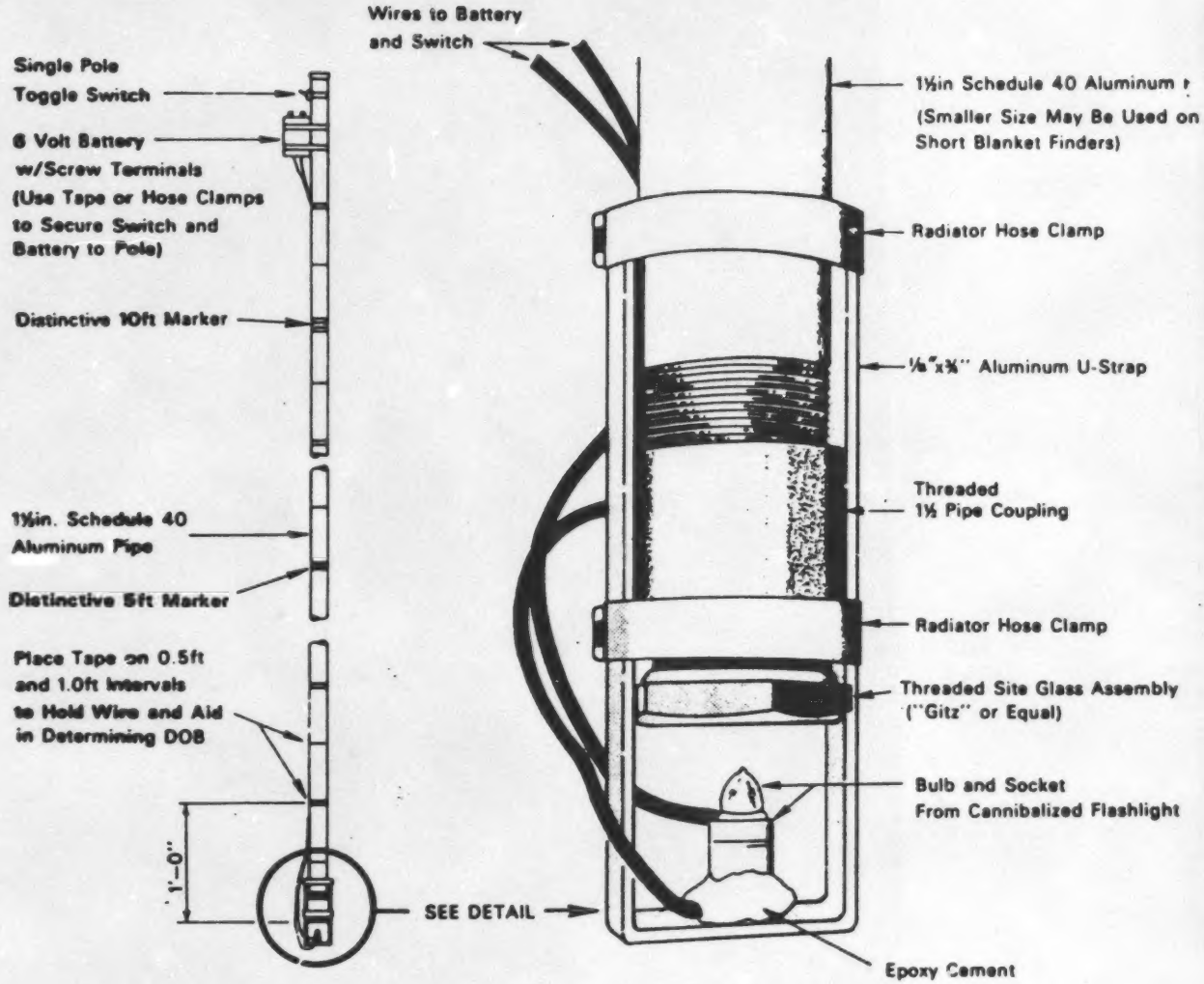
5. Sludge detention times can be determined in gravity thickeners and primary clarifiers by measuring the influent and effluent solids and making comparison to sludge volume and average concentration.

CONSTRUCTION OF BLANKET FINDERS

Below are diagrams that can be used to build a blanket finder. The length should be such that you can observe the blanket while standing on the cat walk. Due to rising blanket problems two blanket finders may be required - one long, and one short.

MATERIALS LIST FOR BLANKET FINDER - PAGE S-BK-10 of 16

1. 20 ft, 1½" schedule aluminum pipe
2. 1 single pole, singel throw, toggle switch
3. 1 6-volt lantern battery with threaded connection
4. 2 1 3/4" st. st. hose clamps
5. 1 1½" threaded coupling
6. 1 site glass 1½"
7. 1 6-volt bulb and socket - flash light type
8. 40 ft #16 wire
9. 1 roll electricans tape
10. epoxy cement
11. 14" 1/8 X 3/4 aluminum strap

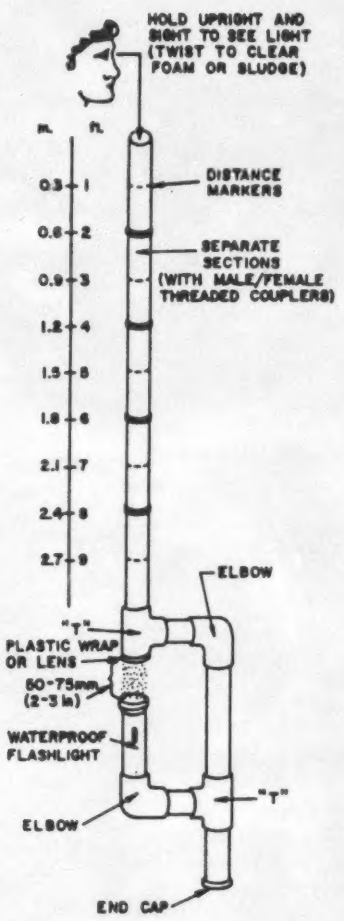

Wires to Battery and Switch
Single Pole Toggle Switch
6 Volt Battery w/Screw Terminals (Use Tape or Hose Clamps to Secure Switch and Battery to Pole)
Distinctive 10ft Marker
1½in. Schedule 40 Aluminum Pipe
Distinctive 5ft Marker
Place Tape on 0.5ft and 1.0ft Intervals to Hold Wire and Aid in Determining DOB
1'-0"
SEE DETAIL
1½in Schedule 40 Aluminum
(Smaller Size May Be Used on Short Blanket Finders)
Radiator Hose Clamp
⅛"x¾" Aluminum U-Strap
Threaded 1½ Pipe Coupling
Radiator Hose Clamp
Threaded Site Glass Assembly ("Gitz" or Equal)
Bulb and Socket From Cannibalized Flashlight
Epoxy Cement

SLUDGE BLANKET FINDER (NTOTC, EPA)

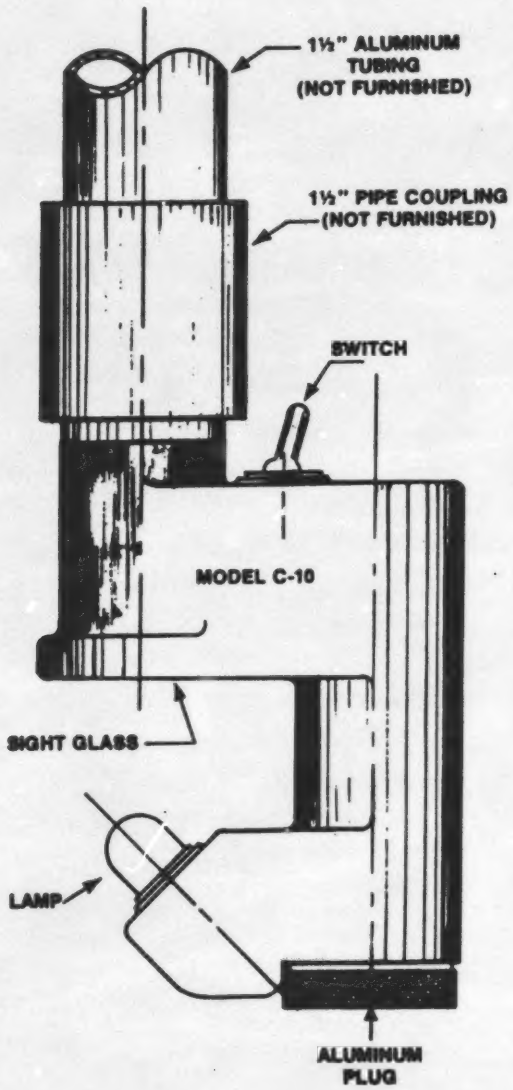
Site Glass Blanket Finder - Taken from WPCF, August, 1980, Deeds and Data. The original article was written by Melvin C. Morse, Chief Operator, Monroe Plant, Monroe, Washington.

MATERIALS LIST

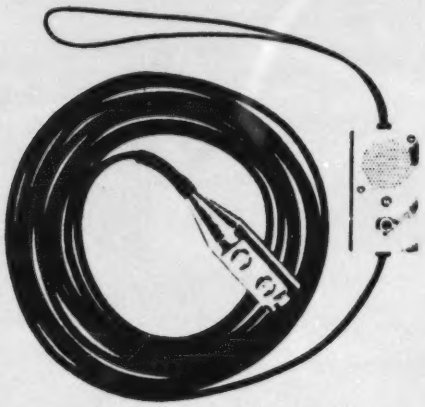
1. Waterproof flashlight
2. 1 lenth of 1½" PVC
3. 1 end cup
4. 2 "tees"
5. 2 elbows - 90 degree
6. 1 male thread adapter
7. 1 female thread adapter
8. 1 site glass
9. tape to mark distance

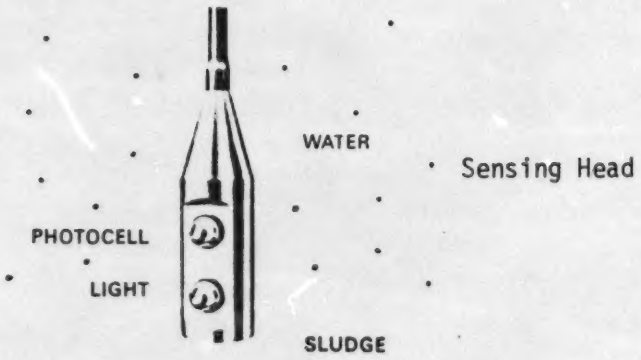


Blanket Finder Head - Manufactured by Raven Manufactured Products
This head may be mounted on 1½" aluminum tubing. Mark tubing in
½ foot intervals.



Electronic Blanket Finder - by Keene Corporation



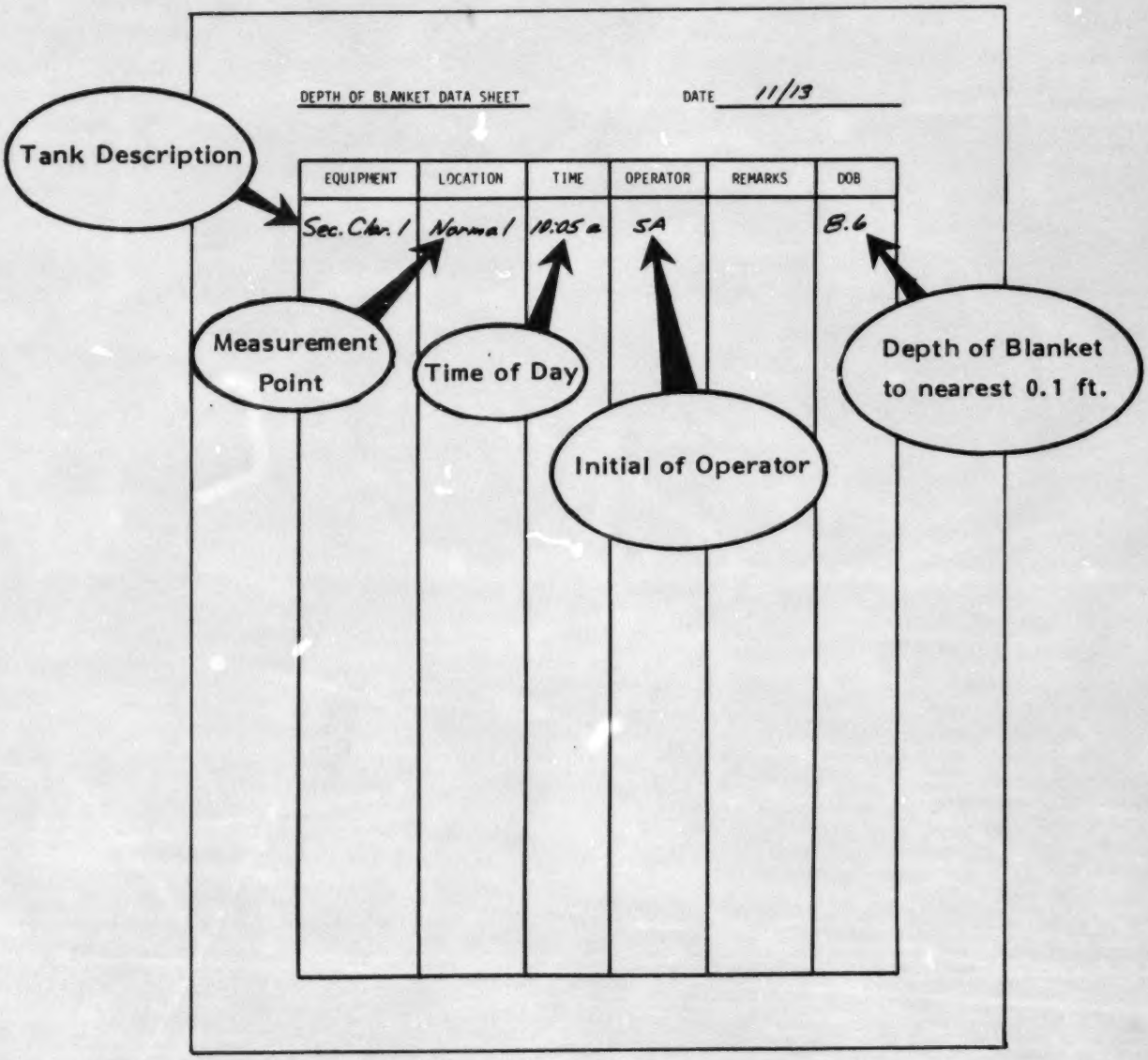


DEPTH OF BLANKET DATA SHEET

DATE _____

EQUIPMENT	LOCATION	TIME	OPERATOR	REMARKS	DOB

SAMPLE DATA SHEET



PROCEDURE SUMMARY

PROCEDURE	CALCULATIONS
1. Select sample site	Not necessary
2. Turn on light	
3. Lower finder	
4. Start observation	
5. Continue lowering	
6. Observe level	
7. Remove finder	
8. Record data	

Depth of Blanket

The above procedure summary is designed as a laboratory aid. It may be cut out and attached to a 5" X 7" index card for convenient reference at the laboratory bench. To protect the card you may wish to cover it, front and back, with clear, self-adhesive shelf paper or similar clear material.

DEPTH OF BLANKET

WORKSHEET

1. On circular tanks the DOB is measured:

   a)_____1/3 the diameter from the wall.
   b)_____1/2 the distance between the wall and center well.
   c)_____2/3 the distance from the left rail.
   d)_____1/3 the radius from the outside wall.
   e)_____None of the above.

2. The major purpose of the blanket finder is to determine the:

   a)_____depth of the tank.
   b)_____concentration of solids in the tank.
   c)_____average height of the dispersed floc.
   d)_____the settling characteristics of sludge.
   e)_____None of the above.

3. When using the blanket finder in determination of solids inventory the measurement that is really wanted is:

   a)_____average clarifier depth.
   b)_____blanket thickness.
   c)_____depth of blanket.
   d)_____thickness of supernatant.
   e)_____None of the above.

4. The blanket finder should be:

   a)_____lowered as fast as possible.
   b)_____lowered at a rate of 0.5 ft/sec.
   c)_____lowered slowly but steadily.
   d)_____lowered in 2 ft intervals making readings after the 5th foot.
   e)_____None of the above.

5. When measuring DOB the valve arms should be at _____degrees to the measuring point.

a)_____180 degrees

b)_____ 25 degrees

c)_____ 45 degrees

d)_____120 degrees

e)_____ 90 degrees

6. You have reached the top of the blanket:

a)_____when the light has just went out.

b)_____when the light first begins to dim.

c)_____one foot after the light creates a glow but the bulb is not distinguished.

d)_____when the light goes out the back one foot.

e)_____None of the above.